DATAS TAXO

User's manual of data backup

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BACKUP AND RECOVERY TECHNIQUES

This document discusses the reasons for maintaining data backup and provides guidelines for designing a backup procedure, some of which may be used to back-up the system disk. Related information on each backup/copy utility is included, to aid you in selecting the appropriate utility for your specific needs. Step-by-step procedures explain how to use the devices on various configurations of TA 1600 computer systems.

1 WHY YOU SHOULD BACKUP YOUR DATA

There is one basic reason to backup your data: to provide a basis for recovery in case part or all of the data suffers loss. Any of the following could make your data inaccessible:

1. Accidental deletion (erasure)
2. Power failure
3. Fire that damages your equipment and/or media
4. Head crash on a disk drive
5. Other hardware failure such as a defective disk controller
6. System software failure
7. Application software failure

TAXO Operating System provides several SCI commands and utilities that facilitate backup and recovery. This chapter discusses each command and presents principles which you can use to organise an effective backup and recovery procedure. This will enable you to recover your data with a minimum amount of time and difficulty.

2 GENERAL GUIDELINES

The following list gives some general guidelines which you can use to check any backup system. If your backup system does not meet the guideline you run a greater risk of data loss, because of the reason given. The guidelines are offered to help you understand how to protect your data.

1. Always keep a log of what is done to the system and when, including backups, hardware maintenance and changes to application and system software. Such a log can help you trace problems and identify methods of preventing recurrence.

2. Never backup current data over your most recent backup. If something fails, you may lose your backup and your current data, leaving you with an old backup or nothing. Use a rotation system involving a minimum of three copies so you never backup onto your latest backup disk.

3. Backup frequently enough to minimise data loss. It is recommended that you backup the data at least once a week when data is not very volatile. You may need to backup most volatile data at least once a day; you have to be the final judge of what is sufficient.

4. Always keep a system disk (one that does not contain current user data) available to use for troubleshooting the system. If your equipment fails in such a way that it erases data or otherwise produces errors on your system disk, you do not want to put your good backup into the disk drive and risk it being destroyed..

5. Always verify a copy operation. Copying without verify saves time in the short run, but it can later turn out to cost a great deal. It is possible for hardware to fail in such a way that data is not copied correctly but no errors are reported by the copy utility.

3 UTILITIES FOR BACKUP AND RECOVERY

TAXO provides a number of utilities to aid you in implementing an effective backup and recovery procedure. There are three categories of backup commands as follows:

1. Volume backup:

   - Copy and Verify Disk (CVD)
   - Disk Copy/Restore (DCOPY)

2. Directory backup:

   - Copy Directory (CD)
   - Backup Directory (BD)
   - Restore Directory (RD)
   - Verify Copy (VC)
   - Verify Backup (VB)

3. File backup:

   - Copy/Concatenate (CC)
   - Copy Sequential Media (CSM)
   - Copy KIF to Sequential File (CKS)
   - Copy Sequential File to KIF (CSK)
   - Copy KIF to Sequential File Randomly (CKSR)

Major features of some of the volume and directory backup utilities are presented in the following table:

	BD	CD	CVD	DCOPY
Seq. backup or copy of entire disk	y	y	y	y
Seq. backup or copy of subdirectory or file	y	y	n	n
Backup or copy to tape	y	n	n	y
Backup or copy between different disk types	y	y	n	n
Self-verification	opt.	opt.	y	varies
Other tasks allowed on system	y	y	varies	varies
Requires system disk to remain mounted	y	y	n	n
Tolerate media errors	y	y	y	n
Limit backup to files created or updated on or after a specified date	opt.	opt.	n	n
Destroys existing data on destination disk	n	n	y	y
Performs limited disk compression	y	y	y	n
Recover space from the end of a KIF	opt.	opt.	n	n
Recover space from the end of a program file	opt.	y	y	n
Recover free space within a program file	varies	varies	n	n

The following paragraphs summarise these utilities and their principal characteristics. For details on their use, refer to the command descriptions.

Your choice of backup utility depends on the hardware configuration you have. One of the benefits of maintaining a regular backup cycle pertains to the compression features of some of the backup utilities. These features allow a better use of the available disk storage space. Disk compression eliminates all possible secondary allocations and collects unused disk space to the end of the disk. File compression, when possible, eliminates holes within a file and collects the unused space to the end of the file. The space remains allocated to the file and is not released to the pool of available disk space. In certain cases this unused disk space at the end of a file can be recovered; i.e. truncated and released to the pool of available disk space. Details on the extent of the compression performed, by each utility, are included in the following paragraphs and in the command descriptions.

3.1 Volume Backup Commands

The CVD and DCOPY utilities copy and optionally verify disks used in the TAXO operating system. The DCOPY utility copies from disk to magnetic tape, magnetic tape to disk, or disk to disk. CVD copies only from disk to disk. CVD and DCOPY require that the input disk and the output disk be the same capacity and type. The directory backup utilities (CD and BD) can also copy or back-up entire disks, and you may sometimes want to use them rather than the volume backup commands to take advantage of options they offer. The principal advantages of the two volume backup utilities are that they are faster than the directory backup utilities, and they do not require the system disk to be physically installed. A disadvantage is that they may require that no other tasks be run on the system while they are running.

DCOPY. This utility copies disks of like type and capacity either directly or via magnetic tape. It preserves all file structures (including inconsistencies, if there are any) and preserves all attributes of the master disk, including the name of the system, to use for IPL (if it is a system disk). It does not require the system disk to be mounted to perform a copy operation and can, therefore, be used to back up a data-only disk in a two-disk system.

DCOPY performs the copy track-by-track with no disk compression. When a copy is made, the destination disk must be the same type as the original source disk even when tape is the intermediate media. When you specify a magnetic tape as the output device in the DCOPY operating procedure, the first and the last records are identification records in ASCII characters. Each identification record contains a volume name, the date of creation, a reel number, and data describing the type of disk from which the tape was created. The reel number contained in the identification records at the beginning and the end of the tape provide the means for copying disks to or from multiple tapes.

DCOPY does not tolerate tracks flagged as bad in the Bad ADU Map on the output disk, which are different to those on the input disk. It is recommended that replacement tracks or sectors (depending on the disk type) be assigned for bad disk locations. If disks have more bad locations than replacable, they should not be used.

CVD. This utility works much like DCOPY except that it does not support tape as an intermediate medium and it is flexible with disk allocation. It does not require the system disk to be mounted to perform a copy operation, so you can use it like DCOPY. CVD runs somewhat slower, but is to be preferred to DCOPY because of its allocation flexibility, as it rebuilds directory structures and performs disk compression (the disk compression includes merging all secondary allocations of a file together into as few allocations as possible). CVD recovers unused space from the end of all files except KIF's. It does not perform compression within a file, which means it does not recover disk space released by deleting records from a KIF or deleting tasks, procedures, or overlays from a program file. If it encounters an unrecoverable disk error, it renders the copy unusable and terminates the copy process.

3.2 Directory Utility Commands

The CD, VC, BD, RD, and VB commands allow you to copy, back-up, restore, and verify directories and/or specific files within directories. These utilities are capable of backing-up single files or directories (in whole or in part) to another disk or to magnetic tape. Since TAXO treats volume names as directory names, they can copy or back up entire disks. They preserve structures internal to files, but rebuild directory structures.

The CD command copies a set of files within one directory to another directory. BD backs-up a set of files within a directory to a single sequential file or a magnetic tape device. RD restores a set of files from the backup file written by the BD command. VC and VB verify the output of the copy and backup commands.

Like CVD, these utilities perform disk compression, but only limited file compression.CD, BD, and RD recover unused space from the end of sequential or relative record files. Unused space at the end of a KIF is recovered only when the KIF COMPRESS option is selected. Neither BD nor CD can compress space released by deleting records within a KIF. (To effect compression on KIFs, see the CKS or CKSR and the CSK commands.)

Disk compression is limited to the available space on the copy disk. Full compression takes place only if large enough blocks exist on the copy to accommodate whole files. The CD and BD utilities require that the system disk remain mounted, and, therefore, cannot back up a data-only pack in a two-disk configuration. In addition, files may be backed up, selected by the date of their last modification.

The CD and RD utilities work in such a way that the number of records in the copy as shown by an LD or MD reflects the information of the input file header and is not updated gradually as records are put in a file. Therefore, if LD or MD show the correct number records in the copy, it is no assurance that the copy is completed correctly. You must perform a verify operation to be sure.

3.3 File Backup Commands

The CC, CKS and CSK commands allow you to make copies of files. These utilities do not have a verfiy capability and you should, therefore, not depend on these utilities for critical backups.

The primary use of CKSR is to recover data from KIFs that have been damaged in some way (for example, by malfunctioning hardware) or that were under partial logging when a system failure occurred. Like CC and CKS, CKSR is not recommended for backup.

3.4 How these Utilities Affect Physical Record Length

The following paragraphs describe what each of the backup commands does to physical and logical records.

CVD and DCOPY perform no processing that involves physical records or logical records and, therefore, perform no checking of file structure integrity. The files on the copy disk have exactly the same characteristics as they do on the master disk.

The BD, RD, VB, and VC commands preserve physical records and their contents without processing the logical records in a file. The CD command can convert physical length with the SPRL and RPRL options (see command descriptions). These options allow the command to rebuild the file structures involving disk allocation and directories. Even with these options, CD does only a limited amount of formatting and integrity checks are minimal. Without options, there is no integrity check on the logical records. The BD command creates its output file with a logical record length of 80 and a default physical record length. This does not affect their ability to back-up files of any physical or logical record length.

The CC, CKS, CSK, and CKSR commands copy logical records from an input file to an output file or device. The output file can reside on a different medium. Except for the CSK command, an output file is created by the utility, if it does not already exist. CSK requires the output KIF to be already created; which means, you can define whatever physical record length you want. For other commands, the output file is created with the same logical and physical record length as the device, if their logical record length is greater than the record length of the device. Output files that you pre-create, retain the logical and physical record length as you created them.

The CC, CKS, and CSK commands use standard I/O SVCs to transfer logical records to the output file or device. This leaves all integrity checking of logical records to TAXO. File management builds the copy files, and the integrity checking is complete. CKSR performs its own integrity checking on the logical records in the input KIF. Records written to the output file by CKSR use standard I/O SVCs.

4 SOME SUGGESTED PROCEDURES

This paragraph presents some suggestions for implementing a backup procedure, with reasons for each step to be considered (along with any of your own ideas) when setting up procedures to meet your specific needs. In general, you should plan to be able to recover from a total loss of the disk pack, in the drive at the time of failure. This will enable you to recover data, lost because of accidental deletion as well as power failure, severe head crash and controller failure. You may want to plan for recovery from an even more catastrophic loss as noted in the following paragraph.

4.1 Offsite Archive and Computing Capacity

Your data is valuable. If there were to be a fire or explosion or some similar catastrophic event that destroyed your computer installation and media, your business could experience difficulty, depending on how critical the data center is to its operation. You may want to consider archiving backup packs offsite. Based on the cost of recovery, the cost of maintaining extra backups, and the risk of such a loss, you may decide that you need total offsite backup. In many cases, maintaining offsite backup, capable of restoring your data-base completely, is not worth the cost. You may only want to keep your oldest backup offsite. Other methods of handling larger risks (such as insurance) may be appropriate for you.

If you lose your computer and have to replace it, you may need temporary computing capacity, sufficient to perform the minimum amount of work needed to keep your business going until your new computer is installed. Sometimes you can make arrangements with another firm or your local distributor that has a computer similar to yours, so that you have access to such capacity. You must make sure that you save your data and programs in a form that is usable by this alternative system.

4.2 Rotational Backup System

A minimum rotating backup system requires two extra disk packs for each online pack that you want to back-up. Put labels on each pack to identify its position in the rotation cycle and to identify which online pack its backs up. If you use tape cartridges for backup, you need two sets of tape cartridges for each online pack, each set capable of holding the contents of the disk to be backed up. Develop a well-documented system of keeping a written log of which packs were backed up, which pack they were copied to, who did the copy, when the copy was made (date and time), and any other information you may need to identify any problems with the backup cycle. Some common mistakes are to back-up the wrong pack in the cycle, or to back-up to a pack meant for a different online pack.

If you are using magnetic tape, label each tape cartridge in sequence. DCOPY and BD maintain headers and trailers to identify the reels and can detect out-of-sequence reels on restore, but your procedure should not depend on that alone to ensure correct backups.

In addition, check the integrity of the backup media periodically. Magnetic tape wears out and needs to be replaced. Disks can develop soft spots that hold data long enough for verification, but lose the data over time. Plan to check the media periodically to ensure smooth functioning of your backup procedures and to ensure availibility of the data if you need it.

Develop and document contingency plans to use in case that the backup procedure does not work correctly. Such a plan might include backing up the disk with CD or BD rather than DCOPY or CVD. The backup operator can note the files in which errors occurred, and you can recover from the previous backup prior to beginning the next day's business. Your plans should also include keeping extra tapes (and possibly disks too) for archiving extra logs and making extra backups. Any point of the procedure is subject to failure, and you should analyse what you need for recovery at any point.

Develop and document plans for recovery in case of failure during system operation between backups. Such a plan may include extra tapes to archive parts of your actual data base and procedures for when to use them.

5 BACKUP/RECOVERY FOR COMPUTER SYSTEMS WITH FIXED/REMOVABLE DISK STORAGE

In those computer systems equipped with a single disk drive with fixed disk storage such as the 25/25 Mb LARK II, the disk drive accomodates two magnetic disks. One of the disks is a fixed (non-removable) platter and the other is a replaceable disk cartridge. When the fixed disk contains the computer's operating system and other system files (as is the usual case), your data files are (also) on the replaceable disk. In most instances of computer system operation, the disk cartridge containing the data files currently in use is mounted in the disk drive. Additional data files (including backup files) are kept on other disk cartridges that are available for mounting in the disk drive when required.Using the CVD command is normally the best way to backup either the fixed disk or the removable disk when both disks are of the same size. You can use DCOPY in the same way. If the fixed disk unit to be backed up is larger than the removable disk (such as the first unit of the CMD 80/16 Mb f/r disk), it is necessary to use more than one backup disk to fully copy the fixed disk. In that case BD must be used to allow you to change the removable disk during the backup process.

5.1 Single-Drive Fixed Disk Backup Using CVD

When the fixed disk and the removable disk are the same size, CVD can be used to copy from disk unit DSO1 (fixed) to DSO2 (removable) as follows:

1. Prior to removing the cartridge from the disk drive spindle, release any LUNOs assigned to it by terminating applications using it and/or using the appropriate release LUNO command. All terminals except the running backup process have to log off. Unload the removable disk by entering the Unload Volume (UV) command, after which the operating system displays a message indicating that the disk unit has been unloaded.

2. Procedures for installation and removal of the disk cartridge are given in the appropriate part of the hardware manual. Stop the disk drive by pressing the START/STOP button on the drive. When the START/STOP indicator light goes out, remove the disk cartridge and replace it with the disk on to which the backup of the fixed disk is to be made.

3. Press the START/STOP switch to start the drive again.

4. When the disk drive is ready, enter the CVD command. The CVD utility announces the beginning of the execution with the full set of prompts. Always use a hardcopy device (printer) to produce of your backup process.

5. Have CVD perform the copy to DSO2. The operating procedure for the CVD command is detailed in the CVD command description in the TAXO User's Manual II.

6. Remove the backup disk from DSO2. Identify the disk properly and store it as the backup copy of the system disk (DSO1).

7. Replace the disk cartridge that was removed in step 2 in disk unit DSO2.

8. Perform an initial program load (IPL).

All of the data in the backup disk cartridge is now exactly the same, file for file, as that on the fixed disk, except that the files have been consolidated and the volume information updated.

5.2 Single-Drive Fixed Disk Backup Using BD

When a fixed disk unit has a larger capacity than the removable disk you must use the BD utility to back-up the entire fixed disk. This utility allows you to change the removable disk during the backup operation. The backup procedure is as follows:

Steps 1 to 3 : see 5.1

4. When the disk drive is ready, enter the BD command.

5. Have the BD begin the backup to DSO2. The operating procedure is detailed in the BD command description in the TAXO User's Manual II.

6. When the space on the backup disk is filled, you must remove the disk from DSO2 and replace it with another. Each time this is necessary, the following message appears:

   MOUNT VOLUME #N; TYPE $ TO QUIT, Y TO CONTINUE

   Change the disks using the appropriate procedures and check to see if the device is ready. Then enter Y to continue.

7. When the entire fixed disk has been backed up, remove the final backup disk from DSO2. Identify the backup disks properly and store them as the backup copy of the system disk.

Note:

Although the BD utility is able to run when other users are working, you should ensure that the disk to be backed up will not be modified by other programs, otherwise the state of your backup disk will be undefined.

Since the backup was written by BD, it cannot be successfully used to load the system. The Restore Directory (RD) command must be used to produce a copy, which can be used to load the system.

5.3 Single-Drive Removable Disk Backup

You can use the DCOPY or the CVD command to perform a backup of the data on the removable disk. These procedures are more involved than the backup of the fixed disk because they require you to make four disk-to-disk copies. Two extra cartridges are required; one disk cartridge is used as a backup to hold the system data while the fixed disk is being used in the DCOPY or CVD process, the other is used for the retained backup copy of the removable disk. The disk cartridge used to back-up the fixed disk is available for other use, once its data is copied back to the fixed disk at the end of the process unless you decide to use it as the backup of the fixed disk.

CAUTION

In the procedure that follows, do not leave or terminate the CVD or DCOPY program until after data on the system backup disk is restored to the fixed disk. Once the utilities begin, the entire program is in memory and can be used repeatedly until you have finished making copies. Whenever one copy is done, DCOPY or CVD ask whether you want to quit. You must respond NO to this prompt each time until all four copies are complete. If the restoration of data to the fixed disk is not completed properly, you must perform an IPL using an installed system backup disk in DS02. then you can use CVD to restore the system backup disk to the fixed disk.

In the following procedure, the disk on DS01 is called FIXED, the removable disk cartridge containing the data is to be backed up is called FIXBACK and the disk cartridge used to backup the removable disk is called CARTBACK. To make backup copy of data on the removable disk (CART), proceed as follows:

1. Remove CART and install FIXBACK on DS02. Using the DCOPY or CVD command, perform steps 1 through 5 of the backup procedures for the fixed disk to copy FIXED to FIXBACK. The operating procedure for DCOPY or the CVD command is detailed in the TAXO User's Manual II.

2. Remove FIXBACK and load CART in DS02.

3. Copy CART (DS02) to FIXED (DS01).

4. Remove CART and load CARTBACK in DS02.

5. Copy FIXED (DS01) to CARTBACK (DS02).

6. Remove CARTBACK and load FIXBACK in DS02. Properly identify and store CARTBACK as the backup of CART.

7. Restore FIXBACK (DS02) to FIXED (DS01).

8. Terminate the DCOPY or CVD process.

9. Remove FIXBACK and load CART in DS02. If FIXBACK serves as backup of FIXED, properly identify and store FIXBACK as the backup of FIXED.

10. Perform an IPL from the fixed disk.

5.4 Single Disk Drive Data Recovery

In a computer system with a single disk drive, damage that causes loss of stored data can occur to either the fixed disk or the removable disk. If the damage occurs through some malfunction ot the computer system's hardware or software, do not try to use backup disk packs to recover data until the system software has been corrected or the hardware has been repaired and verified as operational by diagnostic procedures. Data recovery procedures can begin once the system is restored to normal operation, or can begin immediately if the data loss, on disk, occurred through improper use of the computer system that is not likely to recur.

If damage causing data loss occurs to the removable disk, the procedure is simply to remove the damaged disk and replace it with the latest version of the backup copy of that disk. Re-enter any data entries made to the damaged disk since the previous backup cycle occurred. Make a backup of the newly restored disk. You may elect to do this before and/or after re-entering the data.

Data recovery is more involved if the damage occurs to the fixed disk, causing data loss of operating system files. The general procedure for data recovery to the fixed disk is as follows:

1. Remove the undamaged removable disk from unit DS02.
2. Retrieve the valid backup copy of the system disk (e.g. FIXBACK) and load it in disk unit DS02.
3. Perform an IPL from disk unit DS02 (FIXBACK). This causes the system to name the removable disk as DS01 (FIXBACK) and the fixed disk as DS02 (FIXED).
4. Use the DCOPY or CVD utility to copy DS01 (FIXBACK) to DS02 (FIXED). This copy process restores the backup copy of the operating system to the fixed disk.
5. Terminate the utility and perform an IPL from the fixed disk unit (DS01). This causes the system to revert to the names normally used.
6. Re-install the disk removed in step 1 and start to re-enter any data made to the damaged disk since the last backup cycle occurred.

Note:

In many application systems the update of files residing on different disk units is not independent. In this case it is necessary to make backups of the two disk units within the same backup cycle. In case of any damage (even if only one disk is concerned) both disk units have to be re-installed.

6 BACKUP/RECOVERY PLAN FOR COMPUTER SYSTEMS WITH DUAL DISK DRIVES

In the discussion that follows, assume that the operating system files are on disk unit DS01, data files may be stored on disk units DS01 or DS02, and all disk cartridges are removable. To backup the system disk (DS01), proceed as follows:

1. Remove the data-files disk pack from DS02 and install the disk pack to be used for backup.

2. Use DCOPY or CVD to copy DS01 to DS02.

3. Remove the backup copy of the system disk from DS02 and properly identify and store it. Re-install the data-files disk pack in DS02.

4. Terminate the copy utility used.

To backup your data files from DS02, proceed as follows:

1. Start the desired backup command (DCOPY or CVD).

2. Remove the system disk from DS01 and load the disk pack to be used for backup.

3. Copy DS02 to DS01.

4. Remove the backup copy of your data files from DS01 and properly identify and store it. Re-load the system disk in DS01.

5. Terminate the copy utility used. Perform an IPL from your system disk.

As for the computer system with a single disk drive, damage that causes loss of stored data may occur to either of the two disk drives. If the damage occurs through some malfunction of the computer system's hardware or software, do not try to use backup disk packs to recover data until the system software has been corrected or the hardware has been repaired and verified as operational by diagnostic procedures. Data recovery procedures can begin immediately if the data loss on disk occurred through improper use of the computer system, that is not likely to recur.

If damage causing data loss occurs to one of the disks, the procedure is simply to remove the damaged disk and replace it with the latest backup copy disk since the previous backup cycle occured. Make a backup copy of the newly restored disk. You may decide to do this before and/or after re-entering the data.

Note:

In many application systems the update of files residing on different disk units is not independent. In this case it is necessary to make backups of the two disk units within the same backup cycle. In case of any damage (even if only one disk unit is concerned) both disk units have to be reinstalled.

7 BACKUP/RECOVERY PLAN FOR DISK DRIVE/TAPE DRIVE COMPUTER SYSTEMS

In a system with non-removable disk(s) and a tape streamer drive, you should backup your disk(s) to magnetic tape cassettes with the DCOPY utility. Label these tapes and store them properly.

If a data disk or data files on the system disk are destroyed, but the operating system is still available, simply restore the latest backup copy of the destroyed disk with the DCOPY utility.

If your operating system is destroyed as well, you must rebuild your system disk using the TAPBLD procedure detailed in the Operating Manual for Winchester Streamer Assembly (BH WSP TAXO Part No. 346.99879). Start with the normal system disk initialisation; however at the point in the procedure, where the standard operating system is to be copied to the system disk, change the tape and use the latest backup of your system disk.

Note:

In many application systems the update of files residing on different disk units is not independent. In this case it is necessary to make backups of the two disk units within the same backup cycle. In case of any damage (even if only one disk unit is concerned) both disk units have to be reinstalled.